

A geothermal approach to Power-to-X Kenya

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MANNVIT
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A Geothermal Approach to Power-to-X (PtX) in El Salvador, Chile and Kenya

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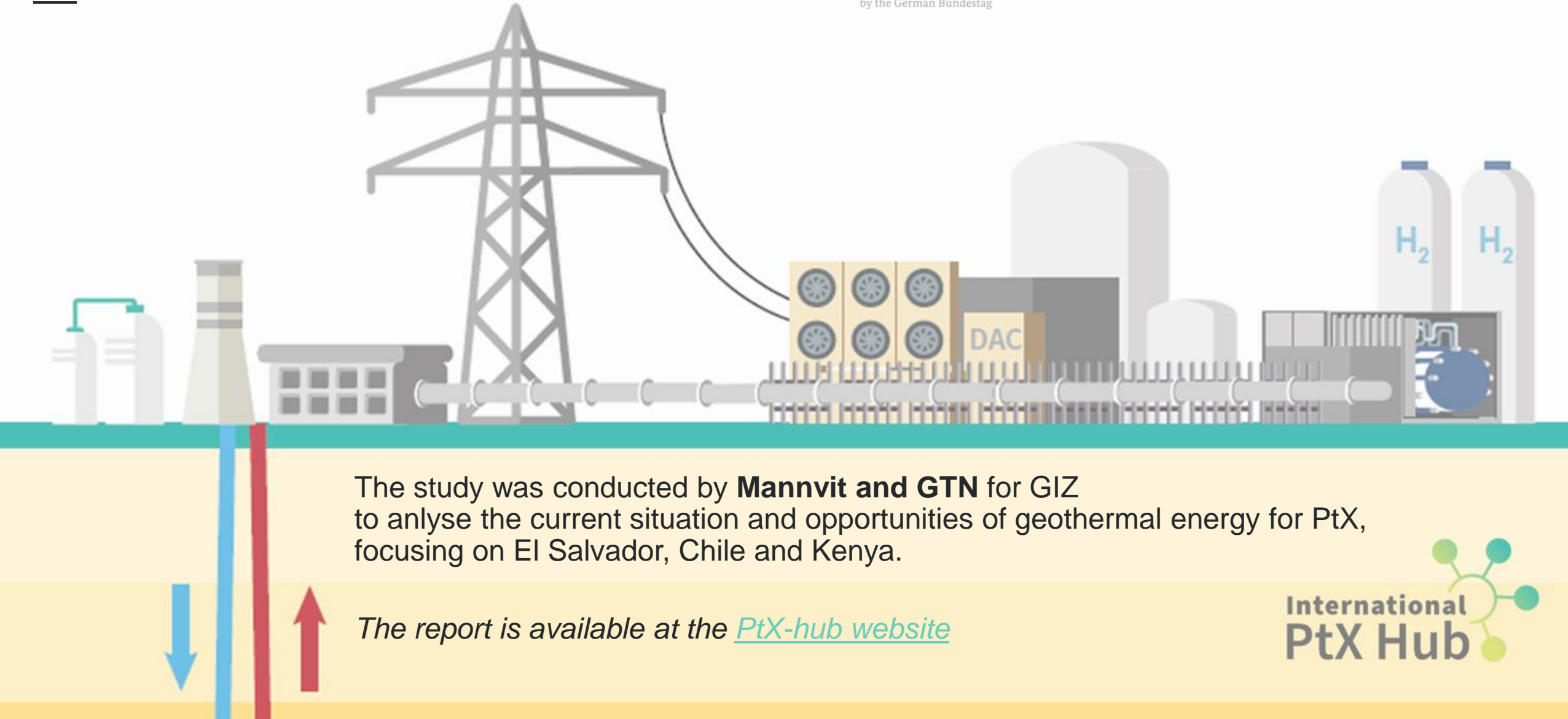
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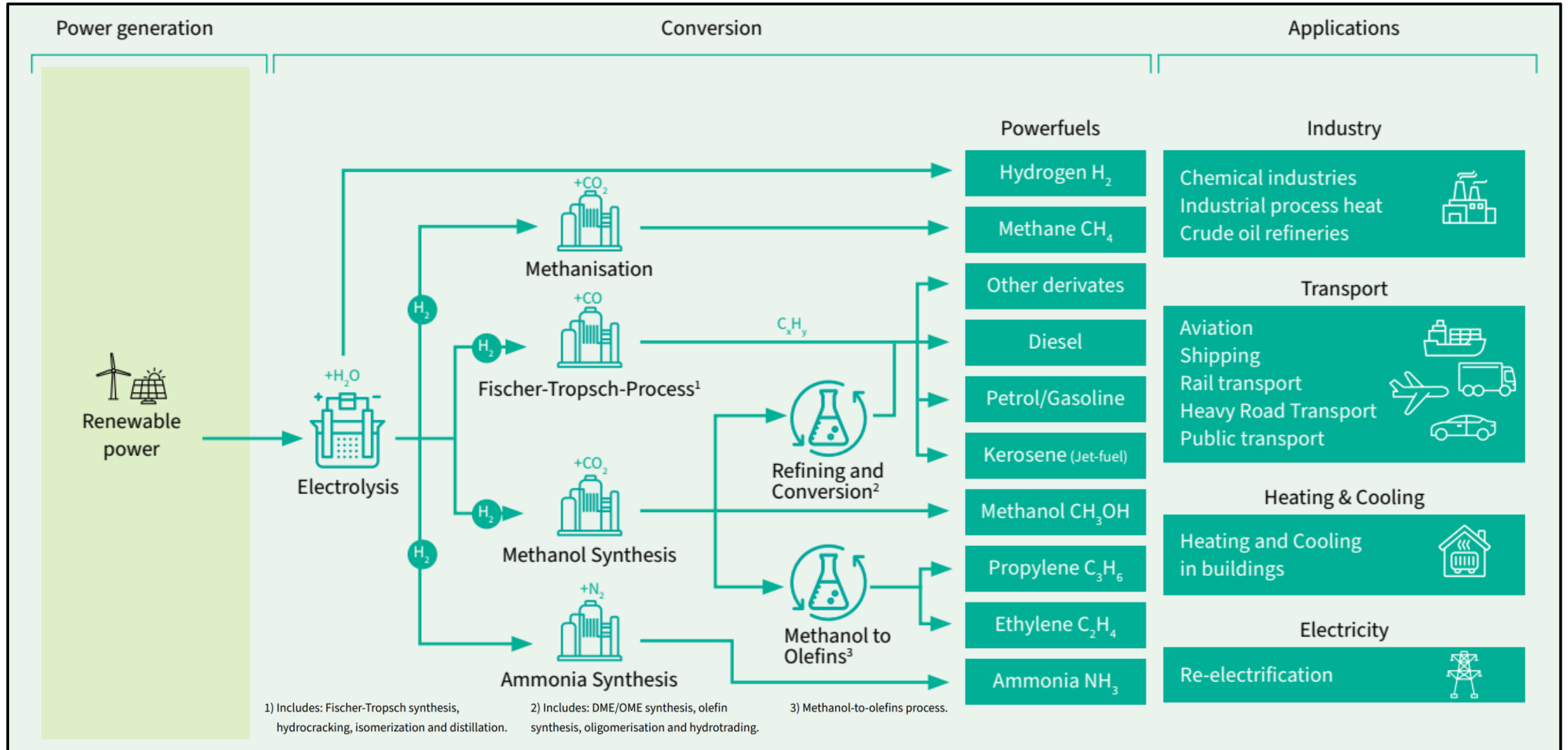


The study was conducted by **Mannvit and GTN** for GIZ to analyse the current situation and opportunities of geothermal energy for PtX, focusing on El Salvador, Chile and Kenya.

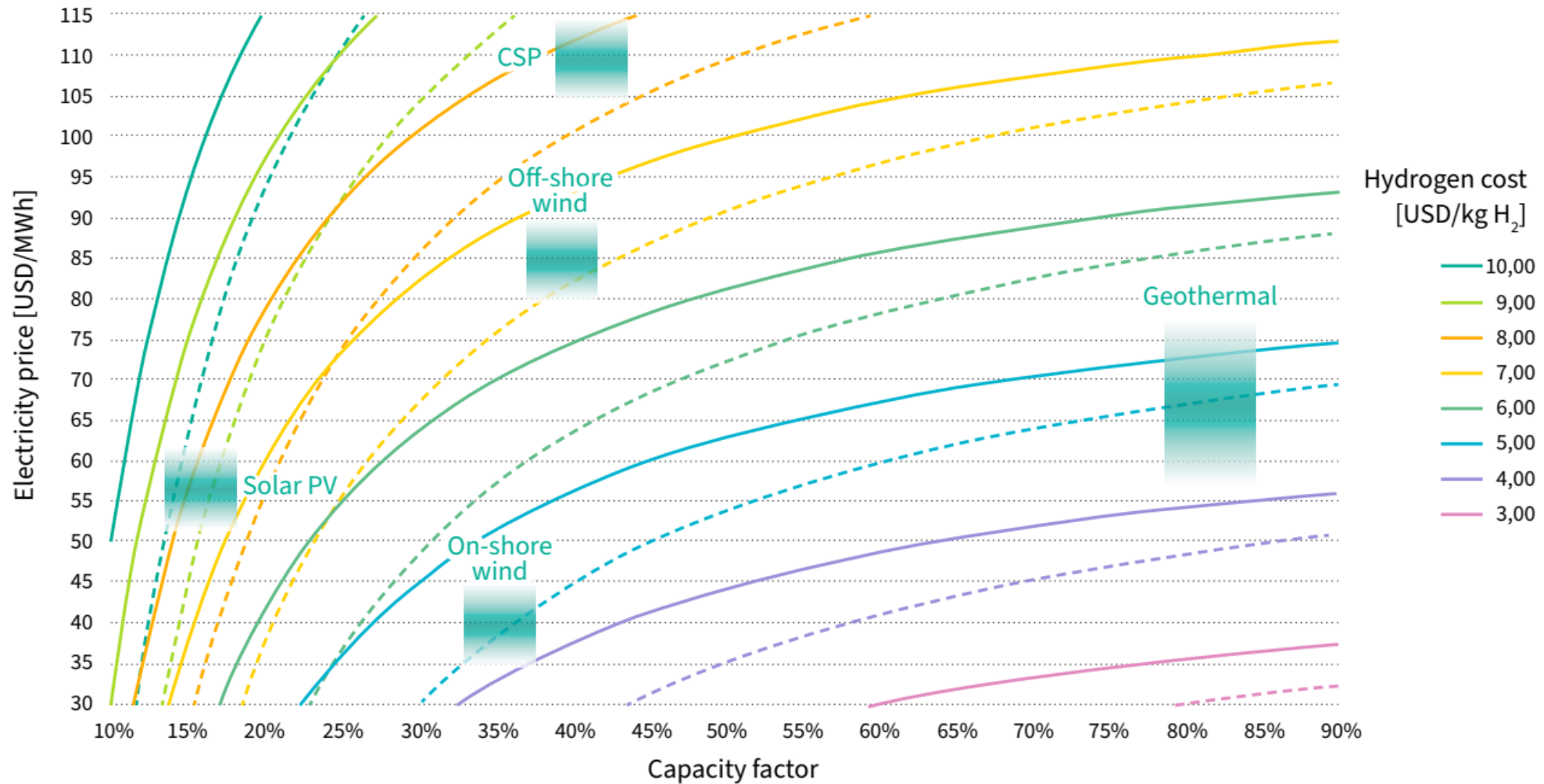
The report is available at the [PtX-hub website](#)



The main powerfuels produced with PtX



Hydrogen production cost



*Unbroken hydrogen cost lines are for AEL electrolyzers, and the corresponding broken lines are for PEM electrolyzers.



Co-benefits of using geothermal sources for PtX

The **stable power** generated by geothermal energy is advantageous as it ensures a high capacity factor.

Direct use of geothermal heat sources e.g. heat supply for SOEC.

The non-condensable geothermal exhaust gas might already contain **H₂** and **CO₂**.

Oxygen as a by-product from electrolyzers is saturated with water vapour and difficult to liquify. It can however be used for various processes in relation to geothermal e.g. fish farming.



Energy status in Kenya

Kenya aims at building a **net zero economy by 2050** and has set a target of transitioning to **100% renewable energy by 2030**.

Kenya's **geothermal capacity growth** has been one of the fastest in the world for the past years. Expansion estimates for renewable energy in 2020-2040 are

- Geothermal power - **up to 800 MW**
- Wind power - up to 1750 MW
- Solar PV - 550 MW

Currently, Kenya has a **renewable energy surplus** during the night and even sometimes during the day.



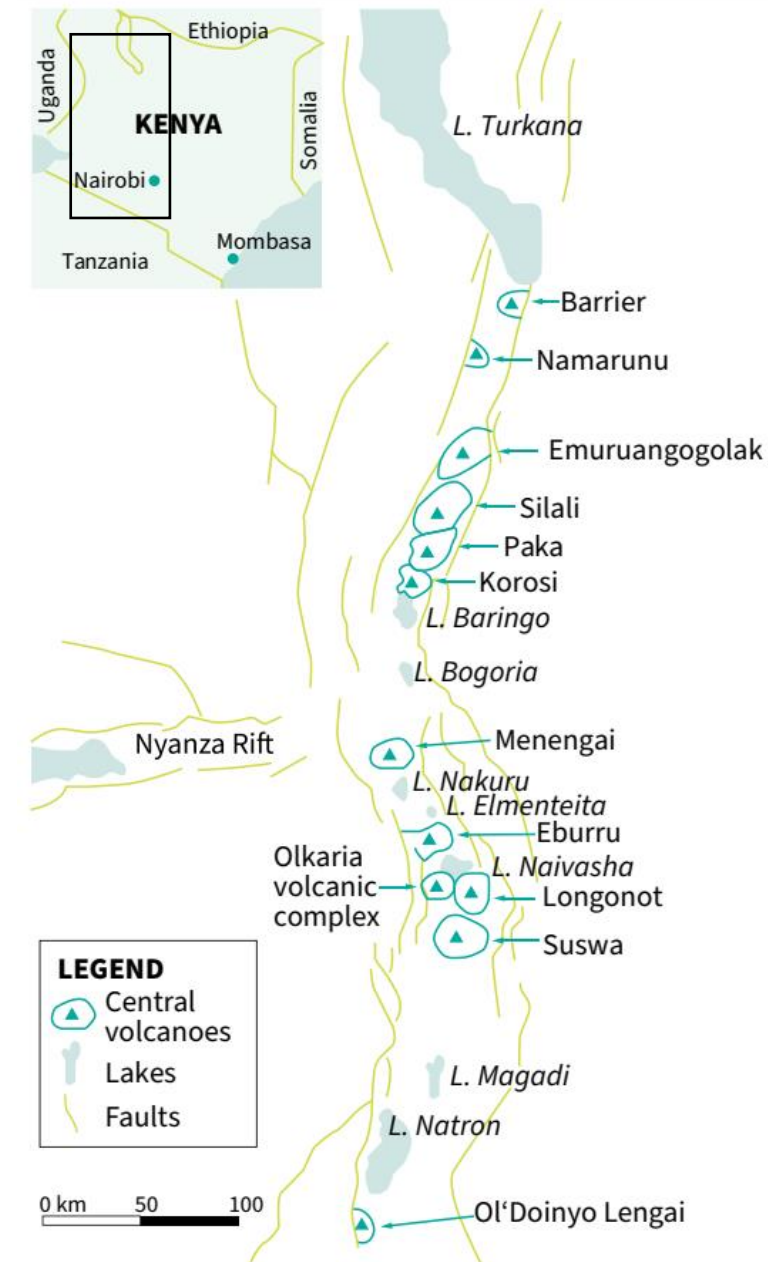
PtX in Kenya

Opportunities for the use of **geothermal and variable renewable technologies** for PtX in Kenya are currently being explored.

A government working group is developing strategies on how the government can support PtX projects.

Three areas have been identified as **high potential for PtX from geothermal** power in Kenya.

- ***Mombasa and surrounding area (Coast)*** due to the vicinity to existing infrastructure and the availability of water from desalination. Electricity must be transmitted from the Central and Western parts of the country.
- ***Wider Olkaria area (Rift Valley)*** due to the vicinity to power generation sources and important power network nodes.
- ***Wider Nairobi area*** due to vicinity of generation sources, availability of infrastructure, industrial processes and service companies as well as research and development.





PtX / Green Hydrogen in Kenya

In a recent study on the potential for PtX / green H₂ in Kenya¹, the main conclusions are that the **opportunities for use of hydrogen** can be split into two fields:

1. As a commodity for chemical and industrial scale uses, e.g. fertiliser production.
2. As an energy source / energy carrier.

¹ Ministry of Energy Kenya; GIZ. Baseline Study on the Potential for Power-to-X/Green Hydrogen in Kenya, 2022.

PtX / Green Hydrogen in Kenya

Pathway	Time frame	Technical potential	Commercial potential and trend	Comparative advantage	Limits / challenges	Climate change effect
1. Fertiliser. H ₂ as a commodity via ammonia	Medium term (start 2025-30 onwards)	300-400/400-500 MW (~1200/1400 MW – region)	(50) – 100 MW Cost decrease expected, but cost shares of RE and non-green H ₂ remain main factors	Competitive if external costs factored in (transport and foreign exchange risks)	Established market (risk), suitable size (scale, CAPEX), water availability	Big but abroad
2. H ₂ / derivatives higher prices commodity for existing / new processes	Short to medium term (2025 - onwards)	10-20 MW (depends on methanol techn. feasibility) + growth potential	1–10 MW (depends on methanol economic feasibility)	Competitive, kick-start development (combine 1 and 3, potential for clean cooking)	Small market with established supply chain / standards	Small, abroad
3. Transport / mobility a) Logistic Port Mombasa b) Public transportation Nairobi c) Large Scale	Short to medium term (2025 - onwards) c) 2030-2040	a) 5 ->10 MW b) x00 MW (uncertain) c) X000 MW (uncertain)	Initial 5-10 MW, depends on funding, R&D; CAPEX to decrease but not competitive without CO ₂ price	(a & b) Confined area, Kick-starts H ₂ development / knowhow PR showcase	a) Limited demand b), c) Technical alternatives (potential lower costs)	a) Small b) Medium c) Big
4. H ₂ as energy / commodity for large scale use	Medium to long term 2030-40	1500-2000 MW (3000-4000 MW region)	Depends on funding, e.g., 50 – 500 MW, huge potential with ongoing technical development	Market / knowhow, Technological progress	Technology, scale / size, Water, costs	Big, abroad
5. H ₂ energy carrier for off-grid supply	Short to medium term	Aggregated 20-40 MW (part of larger base stations)	Depends on funding, uncertain whether niche or mass market	Niche / alternative to diesel and PV-battery	Knowhow / service, costs	Small, Kenya



Main conclusions for PtX in Kenya

One of the greatest opportunities for PtX in Kenya is the **production of ammonia** for fertiliser production.

Kenya could become a **refilling point for ships in the Indian ocean.**

- Global issues and policies related to the blue economy and clean energy for ships are expected to affect port operations.

Local experts also pointed out the importance of considering the following when studying the potential of using geothermal energy for PtX projects in Kenya:

- The **stress on water availability**
- Reduction of **available electricity** for general use
- The short- and medium term **electricity demand** in Kenya





Recommendations to PtX developers

Using **more than one renewable energy source** (at least in the beginning) for PtX projects can be a feasible option.

The location of the proposed project should be studied thoroughly. Important factors to look at are the cost, the market, proximity to labor and prospect of renewable energy development.

Investigate the **energy cost** and options. Make cost analysis before investment decisions are made.

Thank you

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